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# **A randomised clinical *in situ* study to evaluate the effects of novel low abrasivity anti-sensitivity dentifrices on dentine wear**

**Short title:** Clinical evaluation of dentine wear by low abrasivity dentifrices

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**Key words:** Dentine, abrasivity, dentifrice, profilometry, sodium tripolyphosphate, alumina

## **Conflict of interest**

Financial support for the conduct of the study and for editorial assistance in the preparation of the article was provided by GSK Consumer Healthcare. Sarah Young and Charles Parkinson are employees of GSK Consumer Healthcare. Claire Hall was an employee of GSK Consumer Healthcare at the time the study was conducted and analysed. Joon Seong, Emma Macdonald, Sian Bodfel Jones and Nicola West are employees of the University of Bristol, which has received funding from GSK Consumer Healthcare.

## **Author contributions**

All the authors contributed to the design, conduct and reporting of the study. All authors had access to the final study report, made contributions to the development of the manuscript, had final responsibility for the decision to submit, and approved the submitted version.

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# **A randomised clinical *in situ* study to evaluate the effects of novel low abrasivity anti-sensitivity dentifrices on dentine wear**

## **ABSTRACT**

**Objectives:** To compare the abrasive wear on human dentine in an *in situ* model associated with use of an experimental low abrasivity anti-sensitivity dentifrice containing 1% alumina and 5% sodium tripolyphosphate (STP) with an experimental ultra-low abrasivity non-alumina 5% STP dentifrice, a higher abrasivity daily-use whitening dentifrice, and water as controls.

**Methods:** This was a single-centre, single-blind, randomised, split-mouth, four-treatment, two-period, crossover *in situ* study in 29 healthy subjects. Subjects wore bilateral lower buccal appliances, each fitted with four dentine specimens. Study treatments were applied *ex vivo* (three times daily). Dentine loss was measured by non-contact profilometry after 5, 10 and 15 days' treatment.

**Results:** All 29 subjects were included in the efficacy analysis. Significantly less dentine loss was associated with brushing with the low and ultra-low abrasivity dentifrices than with the higher abrasivity dentifrice at all timepoints ( $p < 0.01$ ). Brushing with ultra-low abrasivity dentifrice or water resulted in statistically significantly less dentine loss compared with brushing with the low abrasivity dentifrice at all timepoints ( $p < 0.05$ ). Dentine loss after brushing with ultra-low abrasivity dentifrice was not significantly different from brushing with water.

**Conclusions:** The degree of dentine loss observed in this *in situ* model reflected the abrasivity of the study dentifrices. Brushing with low or ultra-low abrasivity STP-containing anti-sensitivity dentifrices resulted in significantly less dentine loss (equating to dentine wear) than with a higher abrasivity daily-use whitening dentifrice.

## **Clinical significance**

Clinicians aim to prevent or manage tooth wear and subsequent conditions, such as dentine hypersensitivity, while helping patients to maintain good stain control. Lower abrasivity dentifrices would be appropriate for the dental profession to recommend for people susceptible to toothwear.

## 1. Introduction

Dentifrices – particularly daily-use whitening pastes – are typically formulated with dental abrasives, such as hydrated silica, chalk, dicalcium phosphate or alumina [1–3], or with a combination of abrasive and chemical cleaning agents, such as sodium tripolyphosphate (STP), to help control the build-up of stain on the surface of the teeth whilst helping to achieve good hygiene. Polyphosphates, such as STP, are often utilised in dentifrices to supplement the physical mode of action of stain removal offered by abrasives [4].

Particle hardness, shape, size, size distribution and concentration have all been reported to affect the stain-removal properties of dental-grade abrasives [1,2]. These same parameters also influence the rate of abrasive wear, which increases as abrasive particle size increases up to a critical point, after which it becomes independent of size [5, 6]. Dentine is considerably softer than enamel [7], making it more vulnerable to abrasive wear from over-brushing or use of higher abrasivity dentifrices. The effect of abrasivity on dentine should be considered when formulating a dentifrice as most abrasives have a hardness similar to or greater than dentine [8]. Abrasive wear is of particular concern in people with dentine hypersensitivity, where the dentine is exposed, notably at the cervical margin of the tooth [9]. Use of a lower abrasivity dentifrice may be more appropriate for this population to help minimise wear of exposed dentine.

Relative dentine abrasivity (RDA) is a quantitative *in vitro* measure used to assess the abrasiveness of a dentifrice formulation on dentine [10]. It is included in the International Organization for Standardization specification for a dentifrice [11] and is the most widely accepted standardised measure of dentifrice abrasion [12]. Dentifrices with an RDA value up to 250 are considered suitable for normal daily use [11]. Effective extrinsic stain removal has long been associated with higher RDA formulations; indeed, a review of commercially available dentifrices noted that whitening dentifrices were generally more abrasive than other dentifrice products [2]. However, dentifrice formulations containing a low calcined, small particle size alumina abrasive in combination with STP have also been reported to exhibit highly effective stain removal *in vitro* with low dentine abrasivity [13]. More recently, the combination of a small particle size alumina and STP in a low abrasive anti-sensitivity dentifrice has also been shown to be clinically effective at removing extrinsic dental stain compared with a dentifrice containing abrasive dental silica alone [14].

Polyphosphates such as STP have been shown to strongly bind to the surface of the tooth, desorbing protein and chromogens from hydroxyapatite *in vitro* and desorbing the acquired enamel pellicle *in vivo* [15–18]. It is understood that binding of polyphosphates to the surface

of the tooth can cause changes to the surface charge that disrupt protein adsorption [5], thus enhancing the removal of protein-based stain offered from tooth brushing with a dentifrice containing dental-grade abrasive.

*In vitro* and *in situ* methodologies have been established to evaluate the long-term wear potential of abrasives and dentifrices on human dentine and enamel using a number of substrates and techniques [19–21]. An *in situ* clinical study demonstrated significantly less dentine loss following use of an ultra-low abrasivity dentifrice (RDA ~15) compared with brushing with moderate (RDA ~70) or higher (RDA ~240) abrasivity formulations, and no significant difference from brushing with water alone [22], i.e. it showed increased dentine loss (equating to wear) with increasing dentifrice abrasivity.

The aim of this study was to compare the abrasive wear on human dentine of an experimental, low abrasivity anti-sensitivity dentifrice containing 1% w/w alumina abrasive and 5% w/w STP, developed to provide relief from dentinal hypersensitivity and stain removal benefits, with that of an experimental ultra-low abrasivity anti-sensitivity dentifrice containing no alumina and 5% w/w STP, a daily-use whitening dentifrice, and mineral water as reference controls. The null hypothesis was that there would be no significant difference in the abrasion of dentine from tooth brushing with the three toothpastes of different RDA values. Further, all three pastes would be significantly more abrasive to dentine than water.

## **2. Methods**

### **2.1. Study design**

This was a single-centre, single-blind (specimen analyst), randomised, split-mouth, four-treatment, two-period, crossover, exploratory *in situ* study in healthy subjects. The study was conducted in accordance with the Declaration of Helsinki at the Clinical Trials Unit of the Bristol Dental Hospital and School, with ethical review by an independent ethics committee (South West – Exeter, IRB number 14/SW/0044).

The *in situ* method used in the current study was based on a previously published *in situ* abrasion methodology [19,22]. The model employs removable acrylic mandibular appliances that hold the dentine specimens buccally in the oral cavity. Subjects wear the intra-oral appliances for 5–7 hours on a treatment day; they are removed for *ex vivo* treatment of the dentine specimens. Dentine loss is measured by surface profilometry at intervals over the treatment period.

## 2.2. Subjects

Subjects were recruited by the Clinical Trials Unit. The eligible study population comprised healthy adults aged  $\geq 18$  years with good general and oral health and the ability to accommodate lower bilateral buccal intra-oral appliances. Exclusion criteria included pregnancy; breastfeeding; current or recurrent disease or dental pathology that could have affected the study assessments; any oral appliance/restorations that could have interfered with study procedures; recurrent aphthous ulcers; susceptibility to acid regurgitation; severe gingivitis, carious lesions or periodontal disease; signs/history of dental erosion; and daily doses of medication that was causing xerostomia.

## 2.3. Preparation of dentine specimens and appliances

Dentine specimens were obtained from recently extracted caries-free human third molars. Slices of coronal root dentine with a surface area of 3 mm  $\times$  3 mm were sectioned from buccal and palatal areas of the teeth and set in composite (QuiXfil®; Dentsply IH Ltd, Weybridge, UK), polished with 1200 grit silica powder and 0.3  $\mu$ m alumina powder to produce flat specimens (1  $\mu$ m tolerance) with parallel sides, and ultrasonicated in deionised water after each polishing stage. Before use, a 3 mm  $\times$  1 mm area was scanned by non-contact profilometry (Proscan 2100; Scantron Industrial Products Ltd, Taunton, UK) to confirm that the specimens were flat and within the 1  $\mu$ m tolerance. This included the area of the dentine to be exposed to study treatment and two outer (reference) areas from which changes from baseline were calculated. Polyvinyl chloride (PVC) tape was applied over the reference areas to protect them from abrasion, leaving an approximately 2 mm wide zone of exposed dentine along the length of the specimen for treatment.

During the study, subjects wore lower left and right buccal appliances, each fitted with four dentine specimens (Fig. 1). At the start and end of each treatment day the buccal appliances including the dentine specimens were disinfected in chlorhexidine mouthwash (Corsodyl®; GSK Consumer Healthcare, Weybridge, UK) for approximately 3 minutes and rinsed with tap water before either placing in the mouth or storing overnight. At the end of each treatment day and during the profilometry analysis period, appliances were stored at the study site in moist conditions to ensure the dentine specimens remained hydrated. Before and after profilometry, the PVC tape was removed from the specimens and the appliances were disinfected for at least 20 minutes in a mixture of 0.5% chlorhexidine and 70% ethanol, then rinsed with tap water. After analysis, the PVC tape was re-applied and the specimen re-inserted into the appliance.

## 2.4. Study products

Four study products were tested over two separate treatment periods: two during the first treatment period and two during the second.

- *Experimental low abrasive dentifrice*: 5% w/w potassium nitrate ( $\text{KNO}_3$ ), 1% w/w alumina, 5% w/w STP, 1150 ppm fluoride as sodium fluoride (NaF); RDA ~40 ('low abrasivity dentifrice')
- *Experimental ultra-low abrasive dentifrice*: 5% w/w  $\text{KNO}_3$ , 5% w/w STP, 1100 ppm fluoride as NaF; RDA ~13 ('ultra-low abrasivity dentifrice')
- *Daily-use whitening dentifrice*: abrasive silica, 1450 ppm fluoride as NaF; RDA ~142 (Colgate® Total Advanced Whitening; Colgate-Palmolive Ltd, Guildford, UK) ('higher abrasivity dentifrice')
- *Water*: RDA ~8 (Volvic® mineral water; Groupe Danone, London, UK).

Experimental dentifrices were supplied in plain white tubes, the marketed dentifrice was supplied in its commercial tubes, and the water was supplied in commercial bottles; all were identified by study labels.

## 2.5. Study visits

At screening, subjects provided written informed consent and a medical history was taken, followed by an oral soft tissue (OST) examination. Subjects were provided with a regular fluoride dentifrice (Crest® Decay Prevention; Procter & Gamble, Weybridge, UK) and toothbrush (Aquafresh® Clean Control; GSK Consumer Healthcare, Weybridge, UK) to use at home twice daily for the duration of the study. No other oral hygiene procedures were permitted, with the exception of dental floss if this was part of the subject's normal routine.

At the start of the first treatment period, eligible subjects who satisfied all inclusion and exclusion criteria were randomised to receive two study products during each of the two treatment periods, according to a schedule generated by the Biostatistics Department of GSK Consumer Healthcare. Randomisation numbers were allocated in ascending numerical order by study site personnel. For each treatment period the randomisation schedule indicated which study product was to be applied to which side of the mouth for each subject.

Each subject completed 15 non-consecutive treatment days per treatment period (Monday–Friday only, with a 1 week break between treatment periods) to allow time for profilometry scanning after each treatment period. On treatment days, subjects brushed twice with the standard fluoride dentifrice, once before attending the study site and again in the evening

after all study assessments had been completed. During each treatment day, subjects wore the intra-oral appliances (lower left and right) for approximately 6 hours and attended the site three times for *ex vivo* application of study treatments (at 09:30  $\pm$  30 minutes, 11:30  $\pm$  30 minutes and 14:30  $\pm$  30 minutes). Appliances were worn for at least 1 hour before the first product application and for a minimum of 1 hour following product application. Appliances were removed for up to 1 hour and stored in a moist pot while the subjects had lunch.

On treatment days, subjects were not permitted to eat or drink (other than water) while the appliances were *in situ*, and were required to abstain from smoking and chewing gum. Subjects were not permitted to wear any mouth piercings or tongue jewellery during treatment periods, and were requested to delay having any non-emergency dental treatment until after completion of the study (including professional whitening treatments or prophylaxis).

## **2.6. Study treatment administration**

For each treatment, 1.1  $\pm$  0.1 g of the allocated study dentifrice was applied *ex vivo* by site personnel to the four dentine specimens, held in either the left or the right buccal appliance, using an electric toothbrush (Oral B® Vitality Precision Clean power toothbrush with EB 20 Precision Clean Oral B brush head; Procter & Gamble, Weybridge, UK). Study treatments were dispensed by study staff directly onto a wetted brush then applied to the study samples. All four dentine samples in a particular appliance were brushed for a total of 60 seconds (15 seconds per sample) then rinsed with bottled mineral water. For the water control, dentine specimens were brushed *ex vivo* for 60 seconds using the electric toothbrush while immersed in 50 mL of the bottled mineral water, then rinsed as above. The same member of staff administered the study products for a particular subject for the duration of the study. The staff member was trained prior to the start of the study to brush with a force of 200 g. Appliances were returned to the mouth immediately after rinsing.

## **2.7. Assessments**

A non-contact profilometry scan was taken of each dentine specimen before treatment and after 5, 10 and 15 days' treatment, for measurement of dentine loss. A Proscan 2100 non-contact profilometer (Scantron Industrial Products Ltd, Taunton, Somerset, UK) was used to capture topographical images of each dentine specimen. A 3 mm  $\times$  1 mm area was scanned and Proscan software used to apply a three-point level to the image by placing the three points on the outer edges of the two control (reference) areas. Any erroneous peaks or



troughs were removed and a three-point height measurement was taken by highlighting the two control areas, followed by the exposed channel. The software calculated any difference in height between the control (reference) and exposed areas. A maximum of 9 days (starting from the Friday on which the specimens were removed) was required to complete the non-contact profilometry analysis before the next 5 days of treatment could commence.

## 2.8. Safety

OST examinations were completed at screening, on the first day of each treatment period, on completion of each treatment period and within 7 days of the final treatment day. Adverse events (AEs) were recorded from the first use of standard fluoride dentifrice until 5 days after the last use of study product. Safety was assessed from treatment-emergent AEs and OST findings. However, as this was an *in situ* study with *ex vivo* treatment application, it was not feasible to evaluate clinically meaningful tolerability of the study products. The safety population was defined as those subjects who were randomised and received at least one dose of study product.

## 2.9. Statistical analysis

No formal power-related calculations were carried out for this study. The outcome variable was mean dentine loss ( $\mu\text{m}$ ), measured by non-contact profilometry on Days 5, 10 and 15. Based on previous studies (GSK Consumer Healthcare, data on file), the within-subject standard deviation at Day 10 was assumed to be 0.86  $\mu\text{m}$  and it was estimated that it would increase by up to 30% (to 1.12  $\mu\text{m}$ ) at Day 15. Using a two-sided 5% significance test, 22 evaluable subjects were required to detect a minimum difference between the treatments of approximately 1.0  $\mu\text{m}$ , with 80% power. Allowing for dropouts and protocol violations, sufficient subjects were screened to randomise a maximum of 30 subjects, to ensure that at least 24 evaluable subjects completed the study.

The primary population for evaluation of study outcomes was the per-protocol (PP) population, defined as those subjects in the intent-to-treat (ITT) population with at least one assessment of efficacy considered unaffected by protocol violation. If more than 10% of data were excluded from the PP analyses, the same analyses were planned to be conducted in the ITT population, defined as those subjects who were randomised, received at least one dose of study product, and had at least one post-treatment efficacy measurement.

Mean dentine loss ( $\mu\text{m}$ ) per treatment was calculated as the mean of the four specimens in each appliance taken at each timepoint, and was analysed using analysis of variance based

on a mixed model with treatment period, location of sample in mouth (left/right) and study product as fixed effects, and subject as a random effect. Pairwise comparisons were conducted at the two-sided 5% significance level. No adjustment for multiplicity was planned.

### **3. Results**

#### **3.1. Subjects**

A total of 32 subjects were screened and 29 were randomised to treatment (Fig. 2). The first subject was enrolled on 14 April 2014 and the last subject completed the study on 18 July 2014. All randomised subjects were included in the safety population (n=29), which had a mean age of 34.7 years (standard deviation 10.87 years); 22 (75.9%) were female. The safety, PP and ITT populations were identical.

#### **3.2. Efficacy**

The higher abrasivity dentifrice group demonstrated the highest dentine loss, followed by the low abrasivity dentifrice, the ultra-low abrasivity dentifrice and the water groups. Table 1 shows the between-treatment comparisons of mean dentine loss, and Fig. 3 graphically demonstrates the mean dentine loss from baseline. Brushing with the higher abrasivity dentifrice resulted in statistically significantly greater dentine loss compared with the other study treatments at all timepoints ( $p < 0.01$ ). The ultra-low abrasivity dentifrice and water led to statistically significantly less dentine loss than the low abrasivity dentifrice at all timepoints ( $p < 0.05$ ). There was no significant difference in mean dentine loss between the ultra-low abrasivity dentifrice and water at any timepoint.

#### **3.3. Safety**

Seven treatment-emergent AEs (five during the first treatment period, two during the second) were reported for five subjects. Of these, five, reported for five subjects, were non-oral, and were not considered to be treatment-related. The two oral AEs (mouth ulceration and sloughing of the left buccal mucosa), both mild in intensity, were reported for a single subject in the second treatment period. The sloughing was a single occurrence and was considered to be related to study product (low abrasivity dentifrice allocated to the left buccal appliance); the ulceration was not considered to be treatment-related. All AEs resolved by study completion. No serious AEs were reported.

## 4. Discussion

Tooth wear is a slow process influenced by a multitude of factors. Studies in the 1970s reported that between 18% and 29% of the population were affected by tooth wear [23]. Lesion progression has been reported to range from 1  $\mu\text{m}$  per week [24] to 7  $\mu\text{m}$  per week [23], with prevalence of both superficial and deep lesions increasing with age [25]. Hand and colleagues found that 56% of the dentate elderly population had cervical abrasion lesions [25]. Observations from these studies, such as fewer carious and calculus-covered teeth associated with increased cervical abrasion, led researchers to conclude that brushing with a dentifrice was the primary aetiological factor in abrasive tooth wear [26,27].

Tooth wear studies are difficult to perform *in vivo* due to problems attaining sufficiently sensitive and accurate measurements. For example, studies employing either comparison of tooth profiles [28] or scratch marks taken from impressions [14] over time have been confounded by limitations in the resolution of the clinical methods and lack of reference points. *In vitro* and *in situ* studies have therefore provided valuable insights into the primary factors affecting abrasive tooth wear. While toothbrushing alone is reported to be minimally abrasive to dentine [29,30], brushing with dentifrice is abrasive to dentine [31]. Furthermore, overzealous toothbrushing [32] and features of the toothbrush head, such as bristle shape and stiffness, can modify the measured abrasivity of an applied dentifrice [5,30,33]. Normal use of abrasive dentifrices is reported to cause little damage to dentine over a lifetime, with cumulative dentine wear over an 80- to 100-year period of normal toothbrushing with dentifrice estimated to be less than 1 mm [31]. However, the degree of toothwear may be greater in individuals who are more susceptible to erosion wear, as demonstrated in a study by West et al, 2012 [34]. The relationship between dentine abrasion and dentine erosion is complex, but on balance, an erosive challenge prior to an abrasive challenge appears very destructive, the erosive challenge being the dominant wear factor depending on the duration and type of acid [35].

This study employed an established *in situ* methodology [22] to explore the effect of brushing with dentifrices of differing abrasivity (RDA) on dentine surface loss. In the present study, the between-treatment trends in dentine loss reflected the increasing RDA values of the study treatments. These findings are supportive of an earlier *in situ* study that also reported significantly greater dentine loss following brushing with moderate or higher abrasivity dentifrices compared with a low abrasivity dentifrice or water [22]. The present study showed that initial rate of dentine loss was faster than the subsequent rate of dentine loss, which was particularly pronounced for the lower RDA pastes. This was most likely as a

result of the dentinal smear layer removal, which is more easily removed than the underlying dentine surface, hence abrasion of dentine was not linear. The higher the RDA of the dentifrice, the more subsequent dentine loss over the same time period. Interestingly brushing dentine with water was no more abrasive than brushing with the experimental low abrasive dentifrice, the oscillation of the values in the results, just over 1  $\mu\text{m}$ , being negligible and within the resolution of accuracy of the profilometer.

The *in situ* methodology employed in this study is sensitive enough to differentiate the effect on dentine wear of brushing with dentifrices of varying RDA values [20,22,32,36]. Assuming a brushing time of 1 minute twice daily, with approximately 1 second of contact with each tooth surface, the treatment methodology of the present study represents wear in the order of 1 year's brushing (each dentine specimen was brushed for 15 seconds, three times a day for 15 days). In reality, much more time is thought to be spent on the first tooth than any other in the brushing cycle [37]. Use of all study dentifrices resulted in low dentine wear values ( $\sim 1\text{--}4\ \mu\text{m}$ ), with the ultra-low abrasivity formulation causing no more dentine loss than brushing with water alone ( $\sim 1\ \mu\text{m}$ ).

Daily-use whitening dentifrices are typically reported to be more abrasive than other dentifrice formulations [2] because they contain abrasive particles that typically have a large particle size ( $>10\ \mu\text{m}$ ) or they are formulated to contain a higher concentration of abrasive components. In addition, whitening toothpastes can also contain chemical cleaning agents. The effect of abrasivity on dentine should be considered when formulating a dentifrice. Abrasive wear is of particular concern where the dentine is exposed, notably at the cervical margin of the tooth [9], and therefore it is important to explore formulation routes that could offer low abrasivity while delivering a stain removal benefit. The utility of low abrasivity dentifrices for individuals with dentinal hypersensitivity in helping to protect exposed dentine from abrasive wear has been demonstrated in this study. Brushing with low or ultra-low abrasivity STP-containing anti-sensitivity dentifrices resulted in significantly less dentine loss than with a higher abrasivity daily-use whitening dentifrice. The increasing level of dentine loss observed reflected the increasing abrasivity (RDA) of the study dentifrices.

In summary the first part of the null hypothesis was rejected as there was a significant difference at all timepoints ( $p<0.01$ ) between the abrasion of dentine following tooth brushing with the three dentifrices, less dentine loss being associated with brushing with the low and ultra-low abrasivity dentifrices than with the higher abrasivity dentifrice. The second part of the null hypothesis was also rejected as brushing dentine with the ultra-low abrasivity

dentifrice was not statistically significantly different in dentine loss compared to brushing with water at any of the timepoints ( $p < 0.05$ ).

The development of very low abrasivity daily-use anti-sensitivity formulations may be of benefit to people with dentinal hypersensitivity, providing relief from this painful condition while helping to minimise dentine wear.

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## Figure legends

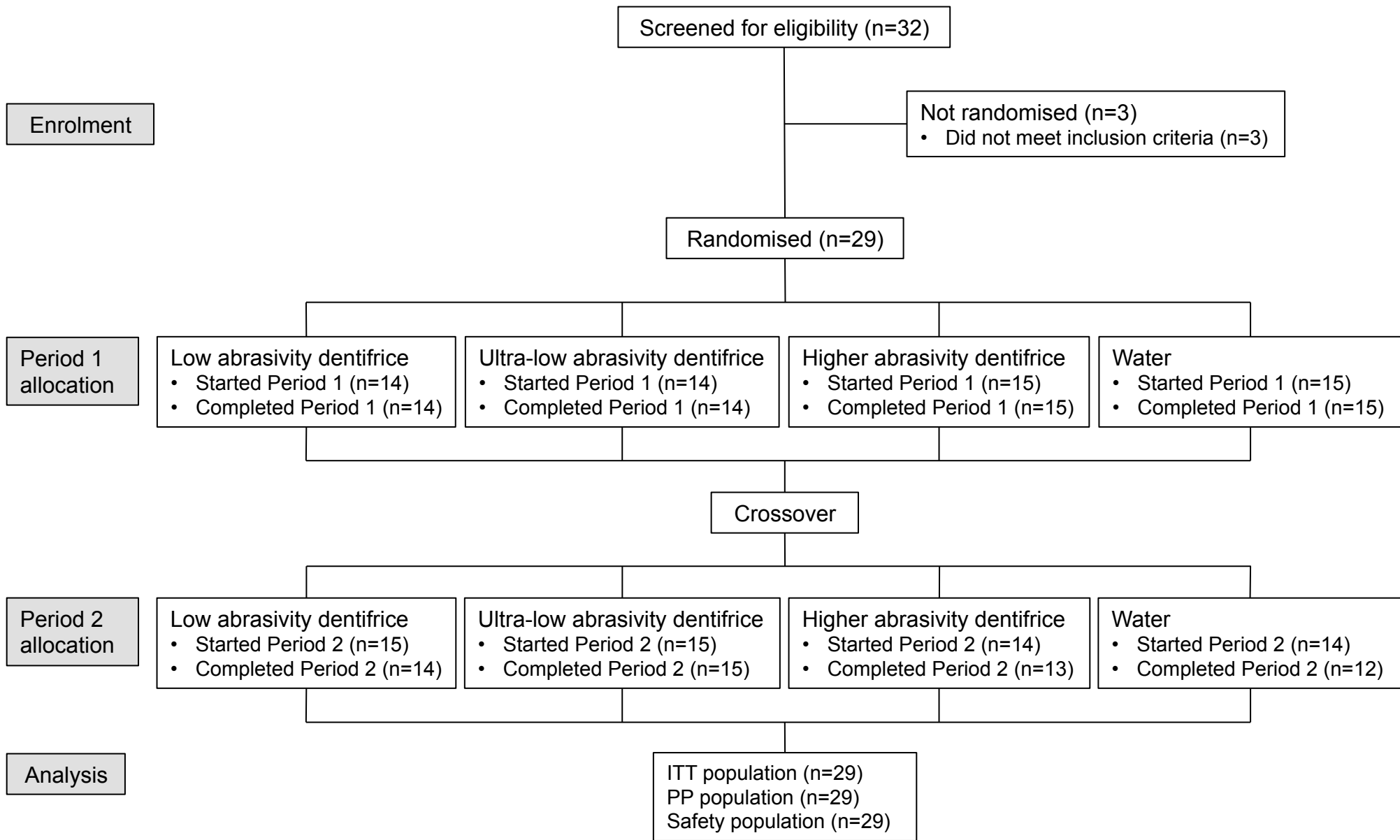
**Fig. 1.** Intra-oral lower buccal appliance showing four dentine specimens *in situ*

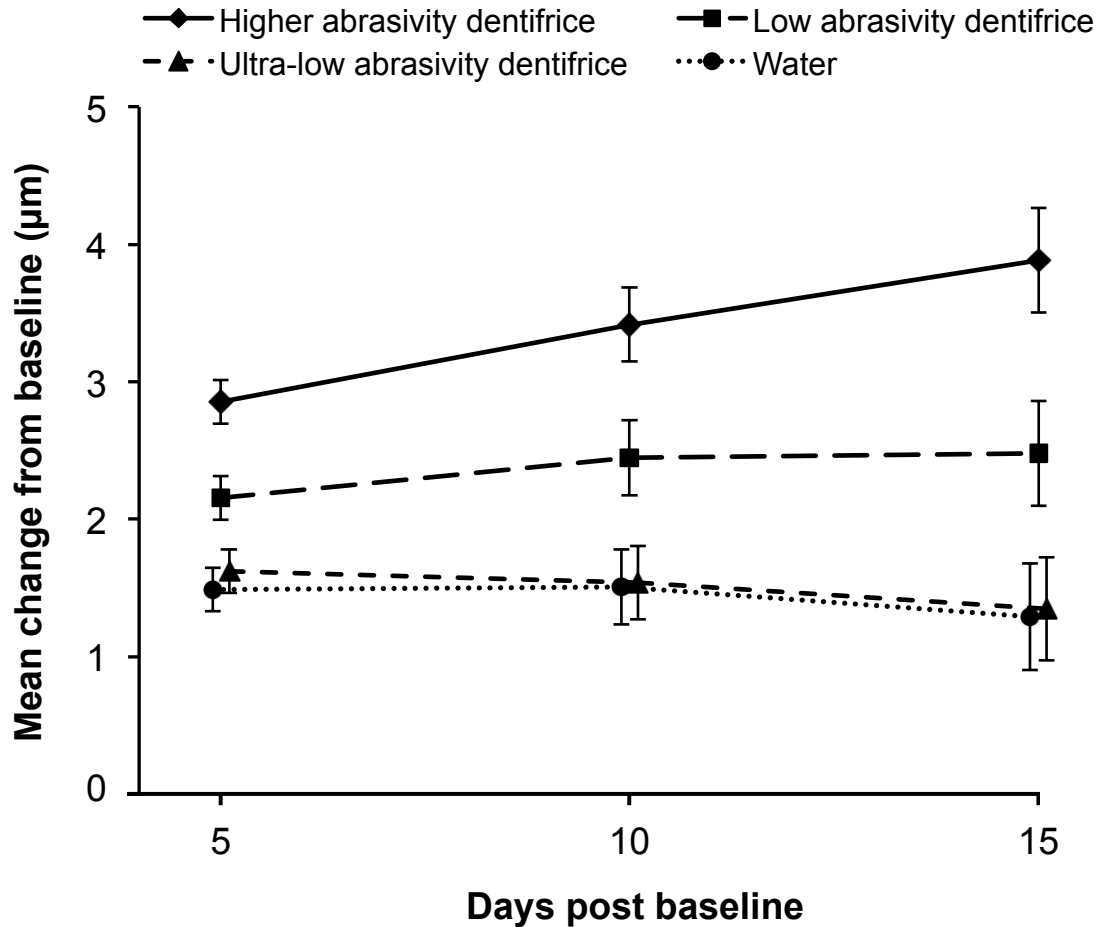
**Fig. 2.** Flow chart of patient disposition (safety population).

**Fig. 3.** Mean dentine loss from baseline (per protocol population)

Data shown are adjusted means  $\pm$  standard errors; data have been offset for clarity







**Table 1.** Between-treatment comparisons of mean dentine loss (µm) over time

Comparison	Day 5		Day 10		Day 15	
	Adjusted mean difference <sup>a</sup> (95% CI)	p-value	Adjusted mean difference <sup>a</sup> (95% CI)	p-value	Adjusted mean difference <sup>a</sup> (95% CI)	p-value
Low abrasivity dentifrice vs higher abrasivity dentifrice	-0.70 (-1.14, -0.26)	<b>0.0021</b>	-0.97 (-1.68, -0.27)	<b>0.0075</b>	-1.41 (-2.38, -0.43)	<b>0.0053</b>
Low abrasivity dentifrice vs water	0.66 (0.23, 1.10)	<b>0.0034</b>	0.94 (0.23, 1.65)	<b>0.0103</b>	1.19 (0.20, 2.17)	<b>0.0186</b>
Low abrasivity dentifrice vs ultra-low abrasivity dentifrice	0.53 (0.09, 0.97)	<b>0.0181</b>	0.91 (0.20, 1.61)	<b>0.0124</b>	1.13 (0.17, 2.10)	<b>0.0222</b>
Ultra-low abrasivity dentifrice vs higher abrasivity dentifrice	-1.23 (-1.67, -0.79)	<b>&lt;0.0001</b>	-1.88 (-2.58, -1.18)	<b>&lt;0.0001</b>	-2.54 (-3.51, -1.57)	<b>&lt;0.0001</b>
Ultra-low abrasivity dentifrice vs water	0.13 (-0.31, 0.57)	0.5493	0.03 (-0.67, 0.74)	0.9287	0.06 (-0.92, 1.04)	0.9083
Higher abrasivity dentifrice vs water	1.36 (0.93, 1.80)	<b>&lt;0.0001</b>	1.91 (1.20, 2.61)	<b>&lt;0.0001</b>	2.60 (1.61, 3.58)	<b>&lt;0.0001</b>

Data are from ANOVA model including subject as a random effect, and treatment period, study product and location of sample in mouth (left or right) as fixed effects

<sup>a</sup>First-named treatment minus the second; a negative difference favours the first-named treatment and is indicative of less dentine loss (lower abrasive wear)

**Abbreviation:** CI, confidence interval